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Enumeration and Biological Data on Arctic Charr from Freshwater Creek, Cambridge Bay Area, Northwest Territories 1982, 1988 and 1991

D.K. McGowan and G. Low

Central and Arctic Region
Department of Fisheries and Oceans
Winnipeg, Manitoba R3T 2N6

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Canadian Data Report of

Fisheries and Aquatic Sciences 878

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by

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ABSTRACT

McGowan, D.K., and G. Low. 1992. Enumeration and biological data on Arctic charr from Freshwater Creek, Cambridge Bay area, Northwest Territories, 1982, 1988 and 1991. Can. Data Rep. Fish. Aquat. Sci. 878: iv + 23 p.

In 1978 a stock assessment program was initiated in the Cambridge Bay area. As part of the initial stock assessment program and specifically in response to concerns by the residents of Cambridge Bay, a study of the charr stock in Freshwater Creek was initiated. A weir, or counting fence, was used to enumerate the upstream migration of Arctic charr at Freshwater Creek in 1982, 1988 and 1991. A summary of the number of charr counted, tagged (1982 only) and live sampled, the biological data collected and the timing of the runs are presented. Biological data collected include length, weight, age and maturity characteristics from a stratified sample. Total number of charr counted were: 1982, 9 961; 1988, 36 933 and 1991, 39 559.

Key words: counting fence; weirs; statistical sampling; enumeration; stock assessment.

RÉSUMÉ

McGowan, D.K., and G. Low. 1992. Enumeration and biological data on Arctic charr from Freshwater Creek, Cambridge Bay area, Northwest Territories, 1982, 1988 and 1991. Can. Data Rep. Fish. Aquat. Sci. 878: iv + 23 p.

En 1978, on a mis en œuvre un programme de dénombrement des stocks dans la région de Cambridge Bay. Dans le cadre du programme initial de dénombrement des stocks et particulièrement en réponse aux préoccupations des résidents de Cambridge Bay, on a entrepris une étude sur les stocks d'ombles chevaliers dans le ruisseau Freshwater. Une bordigue, ou clôture de dénombrement, a été utilisée pour mesurer la montaison de l'omble chevalier dans le ruisseau Freshwater en 1982, 1988 et 1991. On présente un sommaire des données relatives aux ombles dénombrés, marqués (seulement 1982) et échantillonnés vivants, des données biologiques obtenues et des données relatives à la chronologie des migrations. Parmi les données biologiques prélevées figurent les caractéristiques de longueur, de poids, d'âge et de maturité d'échantillons stratifiés. Voici les résultats du dénombrement des ombles: 1982, 9 961; 1988, 36 933 et 1991, 38 559.

Mots clés: clôture de dénombrement: bordigue; échantillonage statistique; dénombrement; évaluation des stocks.

INTRODUCTION

Native subsistence fisheries occur in the vicinity of all communities in the Northwest Territories (NWT) (Yaremchuk and Wong 1989). The Arctic charr Salvelinus alpinus (L.) of the Freshwater Creek/Greiner Lake system on Victoria Island (Fig. 1) have long been exploited by the Inuit of the Cambridge Bay area (Abrahamson 1964). Commercial fishing for Arctic charr began in the Cambridge Bay area at Freshwater Creek in 1961 when the Department of Fisheries (now Department of Fisheries and Oceans (DFO)) established a 10 400 kg quota. However, commercial fishing at Freshwater Creek was discontinued in 1962 due to evidence of overfishing and this activity was moved to the Ekalluk River (Barlishen and Webber 1973). Sport fishing began at least as early as 1963 when the Hudson's Bay Company sponsored a summer long fishing contest at Greiner River (Freshwater Creek) (Abrahamson 1964).

In 1978 DFO initiated a stock assessment program in the Cambridge Bay area. Objectives were to identify separate charr stocks, to determine the size of the migrating component of each stock and to determine the relative contribution of each stock to the commercial fishery (Kristofferson et al. 1984; McGowan 1990). As part of the initial stock assessment program and specifically in response to concerns by the residents of Cambridge Bay, DFO initiated studies on the charr stock in Freshwater Creek. Partial creel census data were collected in 1981 and 1982 and a total creel census was conducted in 1983 (Carder 1991) to determine the extent of the sport fishery. The upstream migration of Arctic charr in Freshwater Creek was first enumerated in 1982 to assess the status of the stock. Results indicated that the stock was depleted.

The Ikaluktutiak Hunter's and Trapper's Association (HTA) of Cambridge Bay imposed a ban on all gillnetting in the Freshwater Creek/Greiner Lake system in January 1988. This initiative, to rebuild the charr stock, was supported by DFO and the Department of Renewable Resources (Government of the Northwest Territories) but has been on a voluntary basis and has been monitored by the HTA and the community. The upstream migration was enumerated in 1988 to determine the status of the charr stock at the onset of the moratorium on gillnetting. As part of the recovery strategy residents of Cambridge Bay requested a reduction in the sport catch and possession limit from the existing four charr daily and seven in possession to one charr daily and seven in possession. This new regulation came into effect in 1991. The upstream run was again enumerated in 1991 to determine whether there was evidence that the recovery strategy was working. This report presents the data collected from the upstream enumeration conducted in 1982, 1988 and 1991.

MATERIALS AND METHODS

FISH WEIR

A fish weir was used in the enumeration of the upstream charr migration. The weir site was located approximately 2.75 km upstream from the mouth of Freshwater Creek (Fig. 2). The 1991 weir site was located 200 m downstream from the sites used in 1982 and 1988. In 1982 the weir was operated from 20 August to 07 September. In 1988 the weir was operated from 20 August to 19 September. In 1991 the weir was operated from 13 August to 12 September.

The trap and fence material utilized in 1982 was similar to that described by Kristofferson et al. (1986) with the exception that a wooden frame and conduit trap (McGowan 1987) was used in 1988 and 1991.

BIOLOGICAL DATA

At the onset of the migration, the trap was checked throughout the day for the presence of fish. When large numbers of charr were encountered a glass-bottomed viewer was placed in the trap next to the front sliding door. As the charr passed under the viewer, they were counted using hand tally counters and allowed to continue their upstream migration.

Each day in 1982 and 1988, 100-150 charr were randomly selected from the trap and sampled for fork length (±1 mm) and round weight (±50 g) and released. Sampling time was staggered throughout the day (50 morning, 50 early afternoon and 50 evening). The number of charr in the trap varied between 75-500 depending on the length of time and the number counted prior to live sampling. In 1982 charr over 450 mm were tagged with Floy (T-bar anchor) tags. The two samples (tagged and live) were combined for all biological analyses. In 1991 all charr held in the trap each day were live sampled. The number of charr allowed into the trap during peak priods of the migration was controlled.

The overall length-frequency distribution of the run was calculated by weighting the daily sample length-frequency distribution by the daily count. The cumulative daily length-frequency distribution was then used to represent the length-frequency distribution of the run in total.

In 1982 and 1991 a sample of charr, stratified by length, was sacrificed to estimate the age-length relationship. Approximately 10 charr from each 50 mm length interval were sampled during the migration. In 1988 a random number table was used to collect a sample of charr. Samples were taken whenever the selected numbers came up during live sampling. Fork

length (±1 mm), round weight (±50 g), sex and stage of maturity (Appendix 1) were noted and the sagittal otoliths removed for age estimation. Ageing technique followed Grainger (1953) in 1982 and 1988. The method of age estimation for the 1991 samples follows Nordeng (1961). Therefore, in this report ages in 1982 and 1988 were reduced by one year to be comparable with those in the 1991 sample. The calculated overall age-frequency distribution of the run was determined by applying the percent of each age group represented in each length interval from the sacrificed sample against the total calculated length-frequency distribution.

Relative condition factor (K) was calculated using the formula:

$$K = \frac{W \times 10^5}{L^3}$$

where:

W = round weight in grams
L = fork length in millimeters

DATA ANALYSIS

Data were analyzed using computer facilities (Micro Vax II) at the Freshwater Institute in Winnipeg, MB. The Statistical Analysis System (1990) Version 6 was used to generate length, weight, age, and sex and maturity summaries. The graphs were produced on an IBM compatible PC computer using Quatro Pro software version 3.0. The maps were produced on an IBM compatible PC using Corel Draw software version 2.01

RESULTS

The total count in 1982 was 9961 charr (Fig. 3). In 1988 it was 36 933 charr (Fig. 4) and in 1991 it was 39 559 charr (Fig. 5). Modal length in 1982 was 550-599 mm (Fig. 6) and length ranged from 200-765 mm. Modal length in 1988 was 350-399 mm (Fig. 7) and length ranged from 199-820 mm. Modal length in 1991 was 400-449 mm (Fig. 8) and length ranged from 215-865 mm.

In 1982 the modal age was 12 years and the range was 6-18 years. In 1988 the modal age was 8 years and the range was 6-17 years. In 1991 the modal age was 9 years and the range was 3-15 years.

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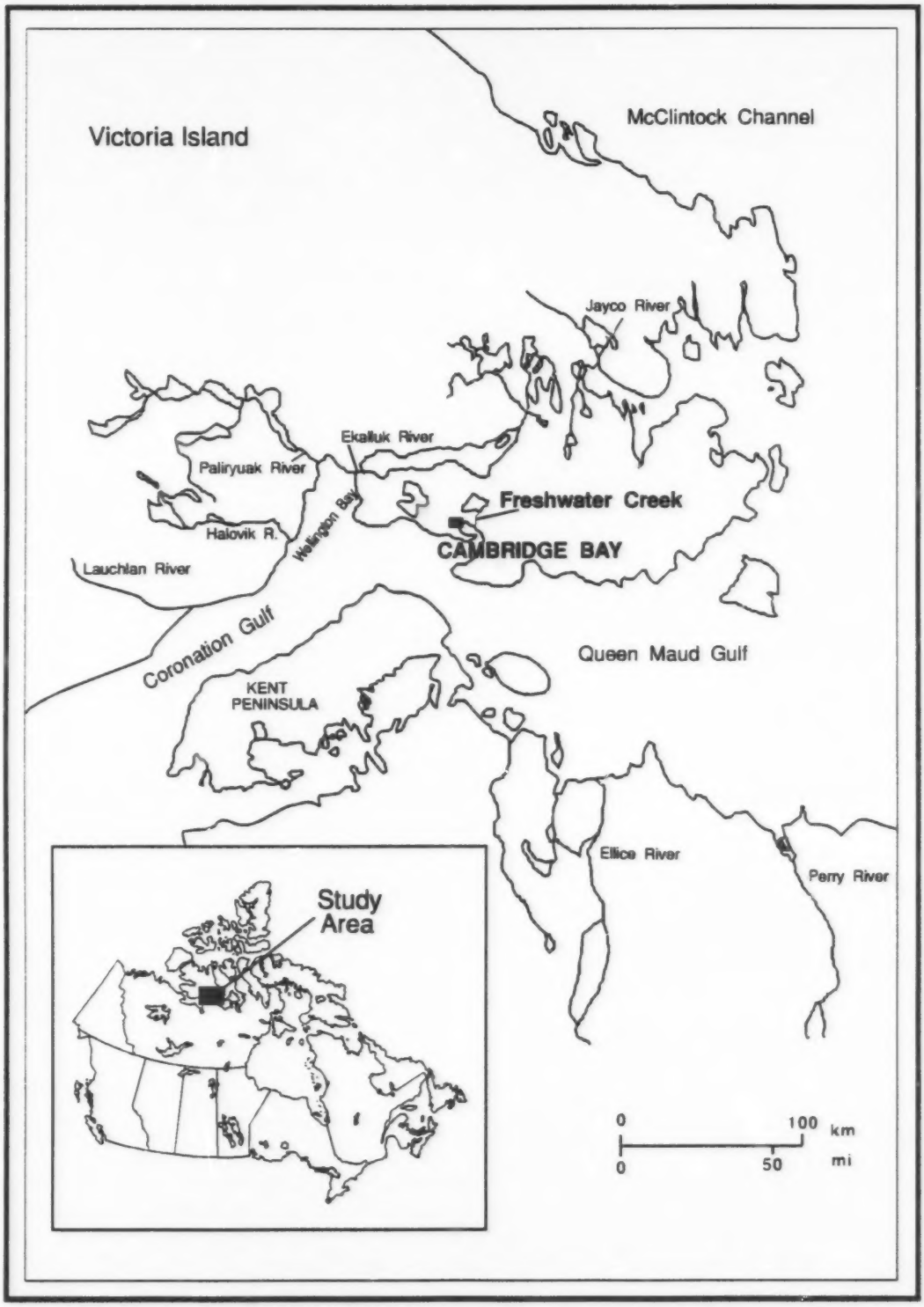


Fig. 1. Map of the Cambridge Bay area showing the location of Freshwater Creek.

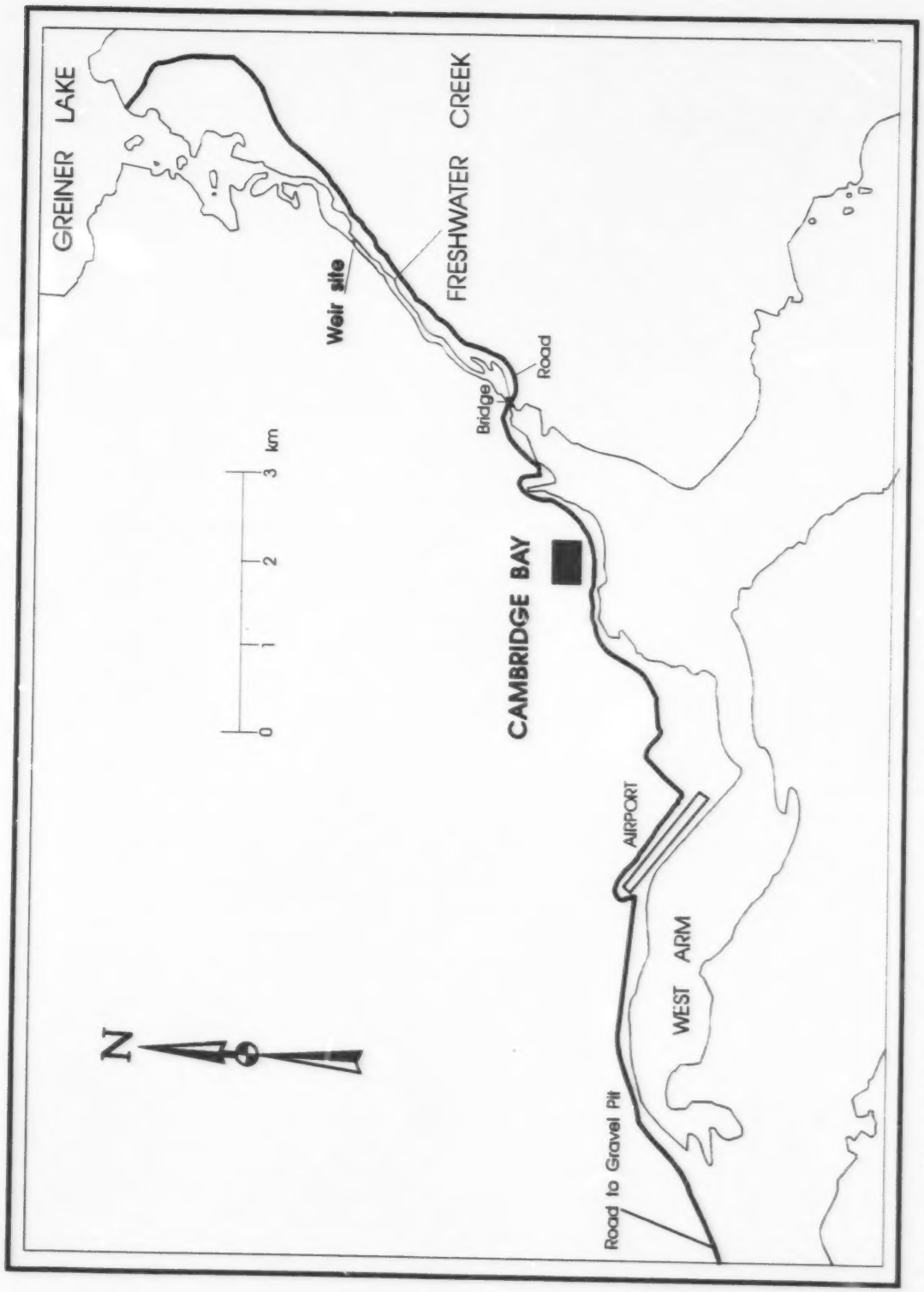


Fig. 2. Map of the Cambridge Bay area showing the weir site on Freshwater Creek.

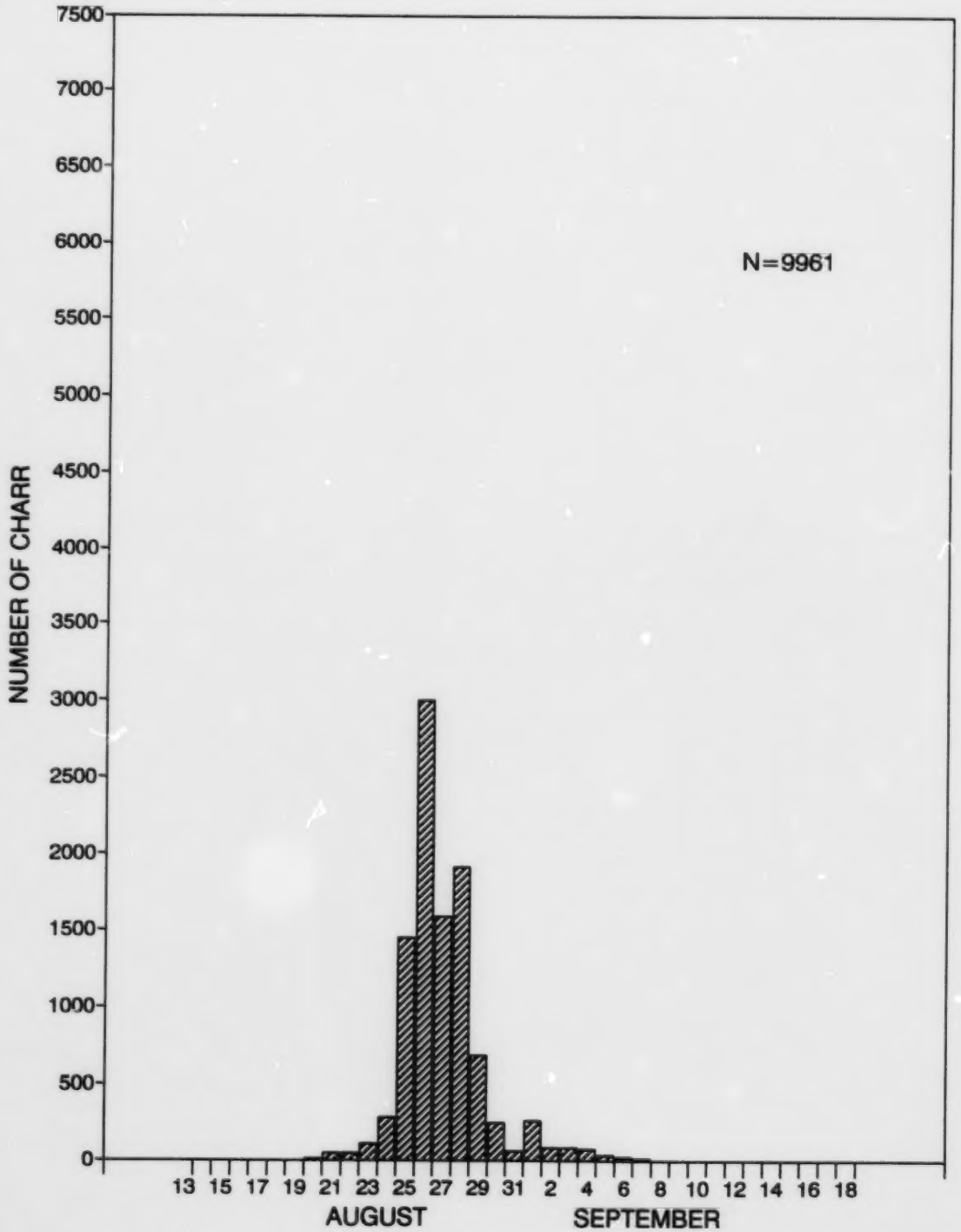


Fig. 3. Daily counts of Arctic charr migrating upstream through the fish weir, Freshwater Creek, 1982.

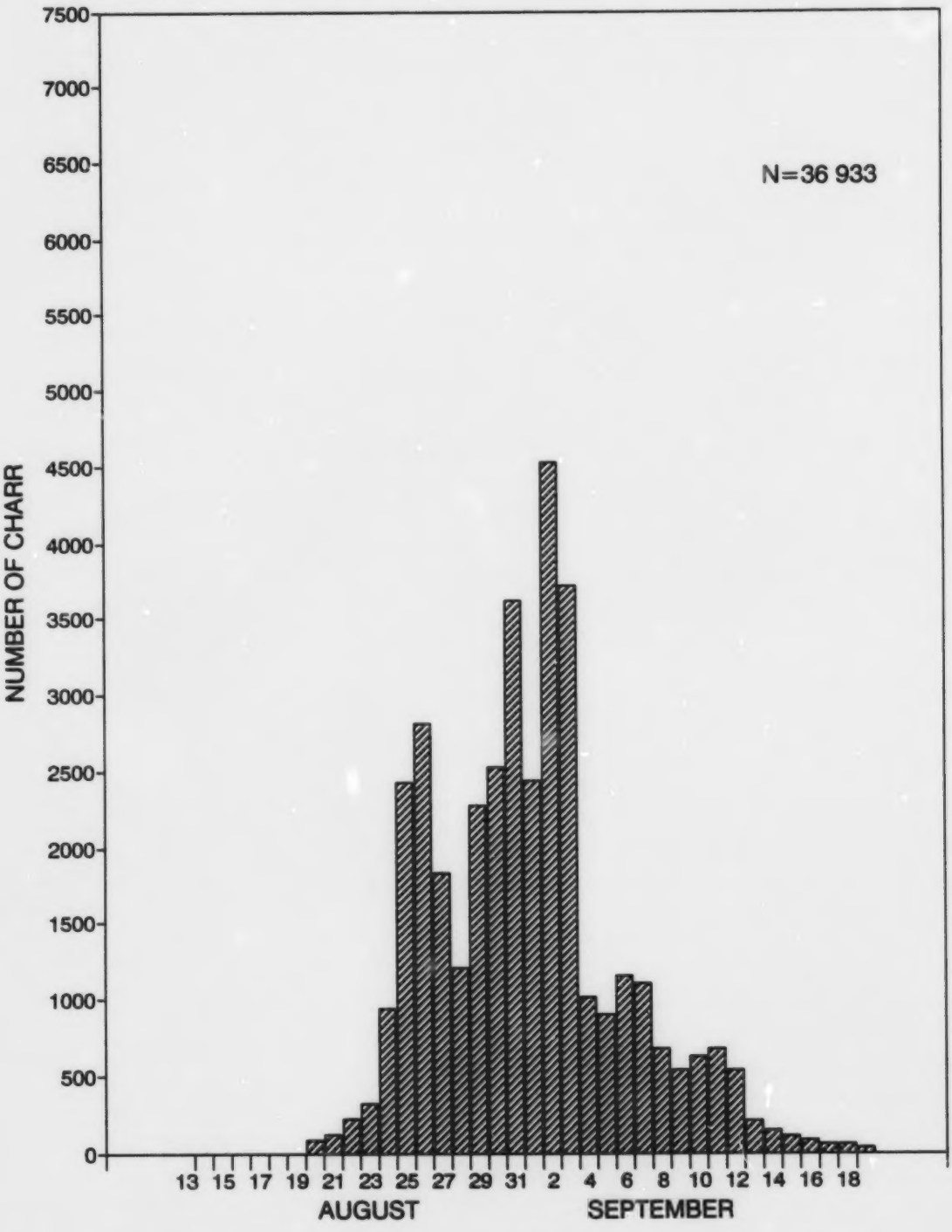


Fig. 4. Daily counts of Arctic charr migrating upstream through the fish weir, Freshwater Creek, 1988.

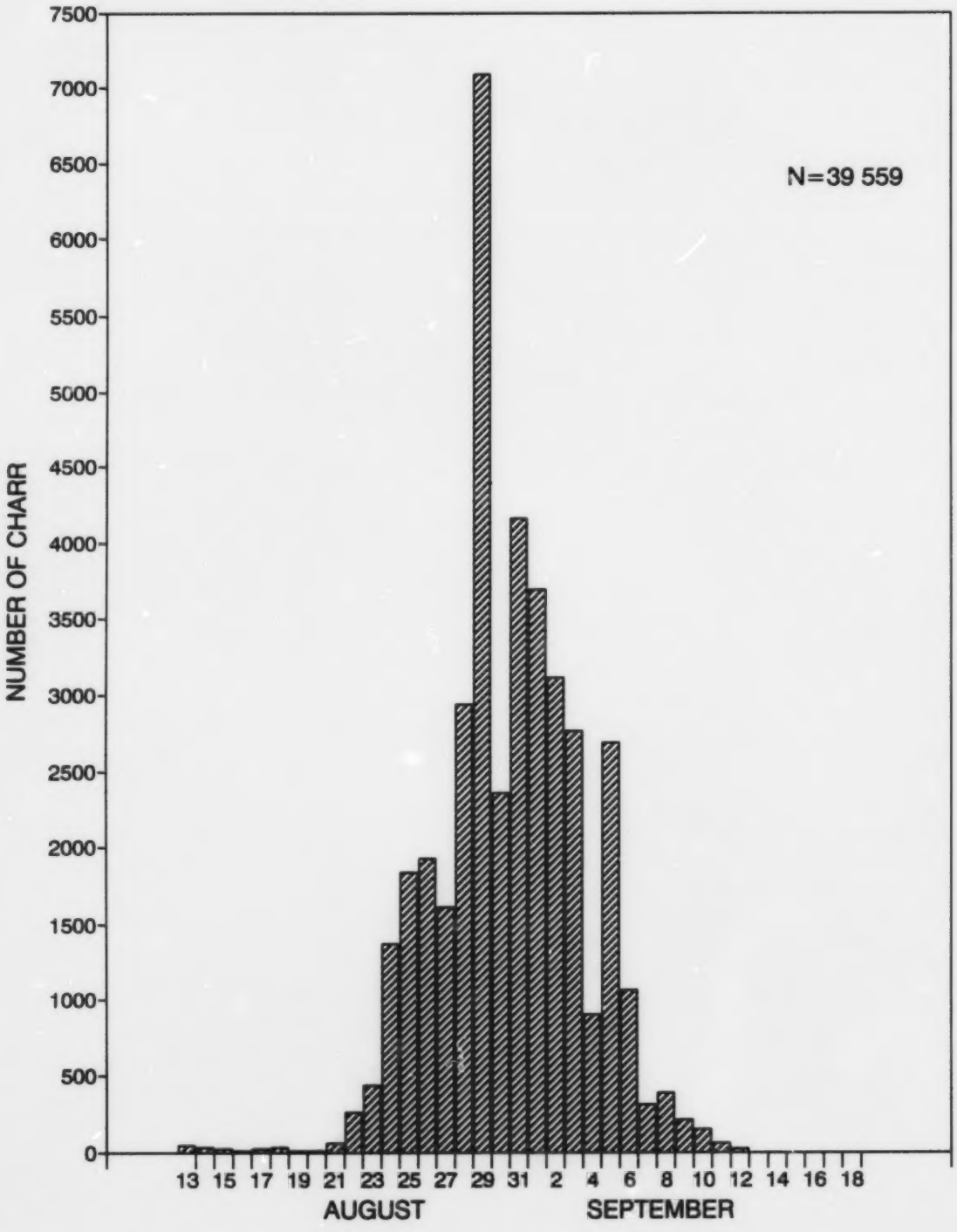


Fig. 5. Daily counts of Arctic charr migrating upstream through the fish weir, Freshwater Creek, 1991.

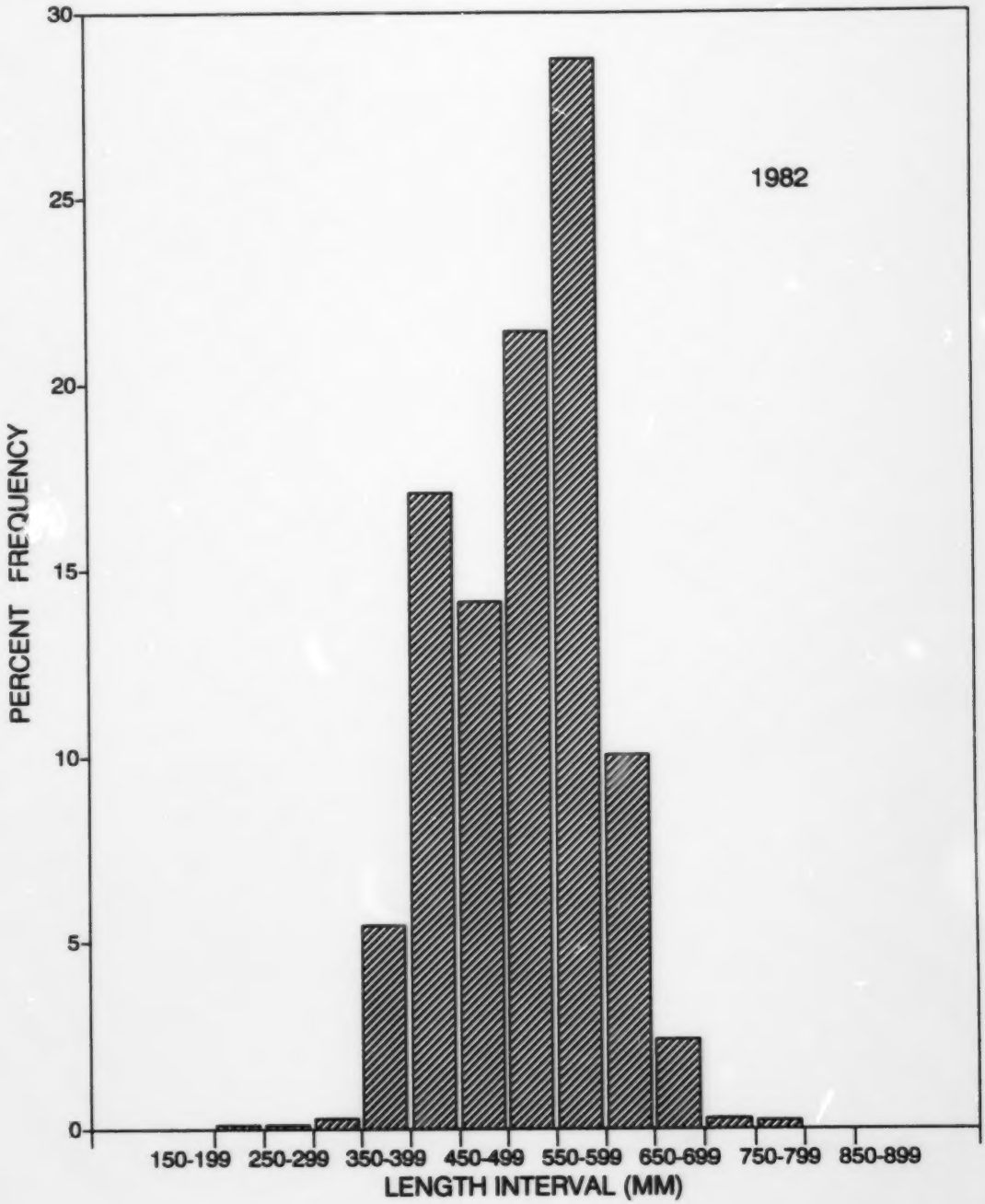


Fig. 6. Calculated length-frequency distribution of the Arctic charr run in Freshwater Creek, 1982.

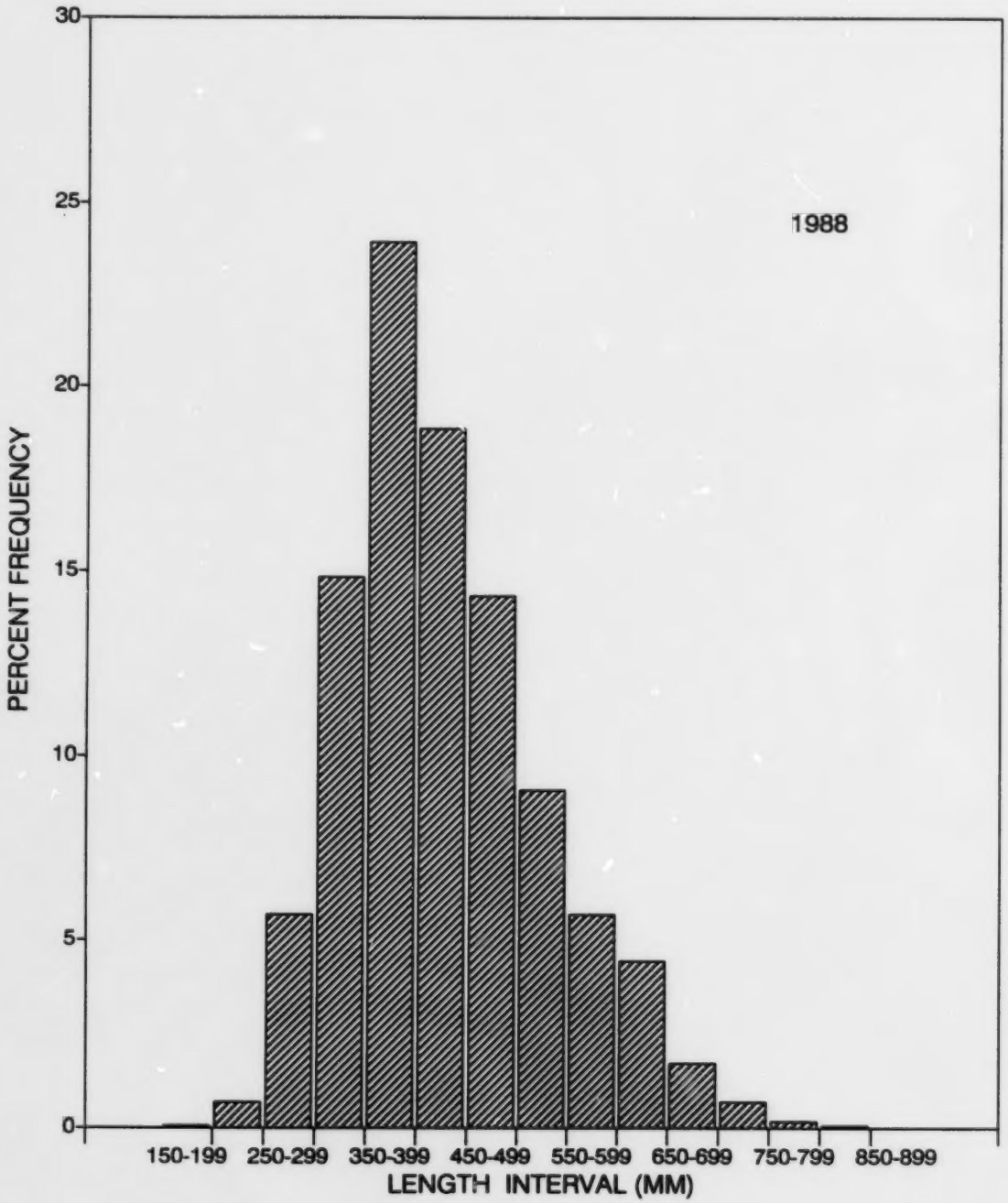


Fig. 7. Calculated length-frequency distribution of the Arctic charr run in Freshwater Creek, 1988.

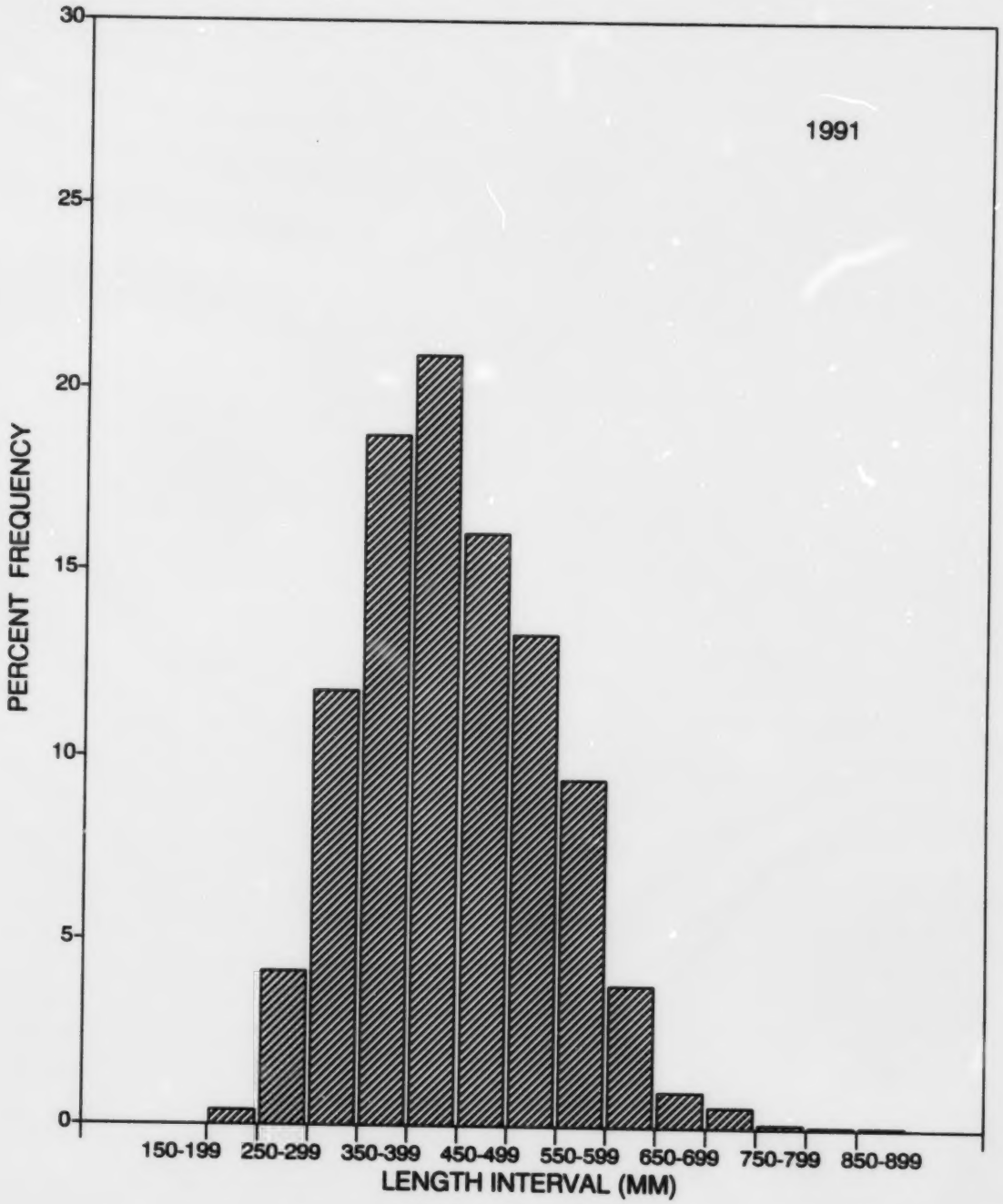


Fig. 8. Calculated length-frequency distribution of the Arctic charr run in Freshwater Creek, 1991.

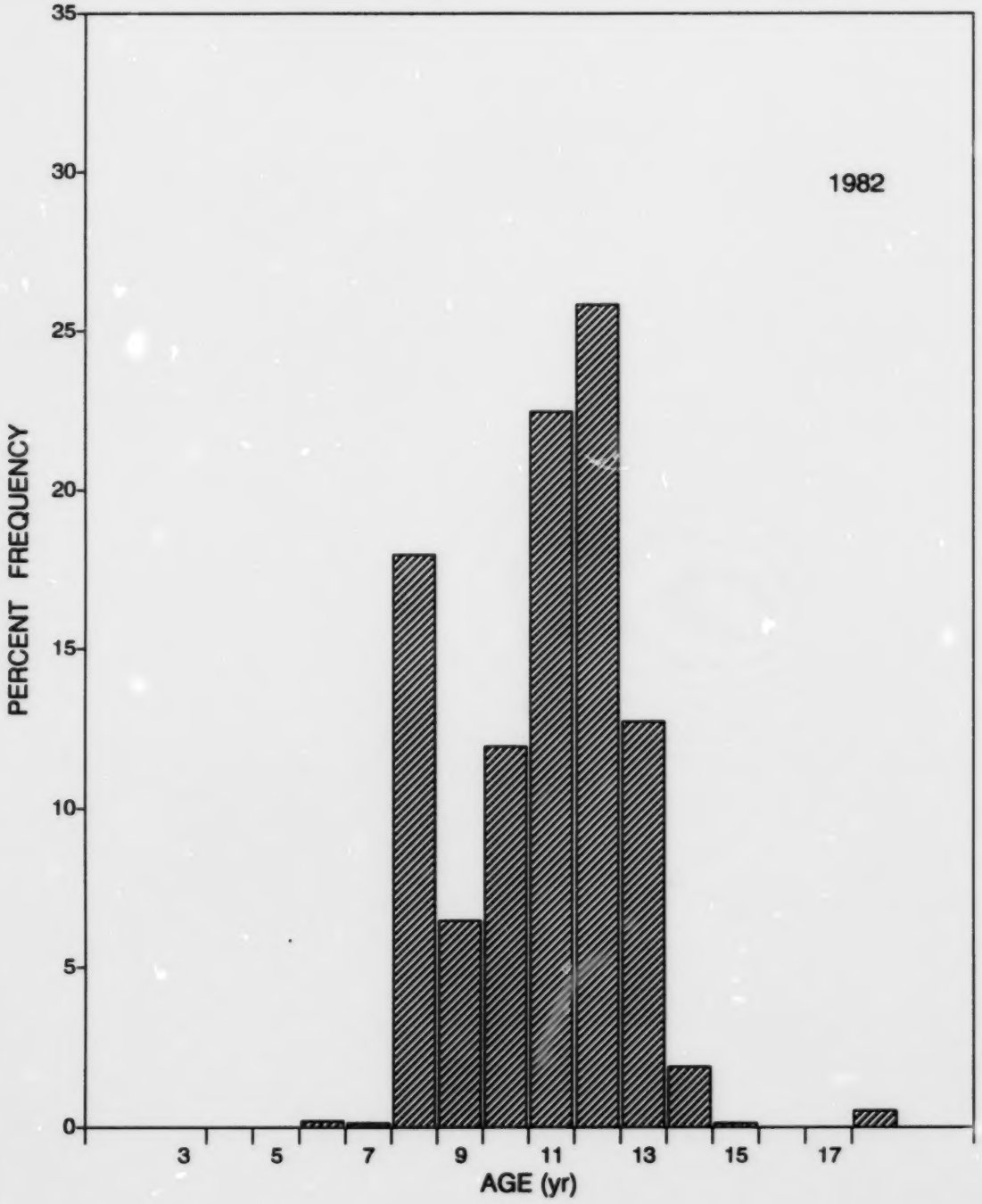


Fig. 9 . Calculated age-frequency distribution of the Arctic charr run in Freshwater Creek, 1982.

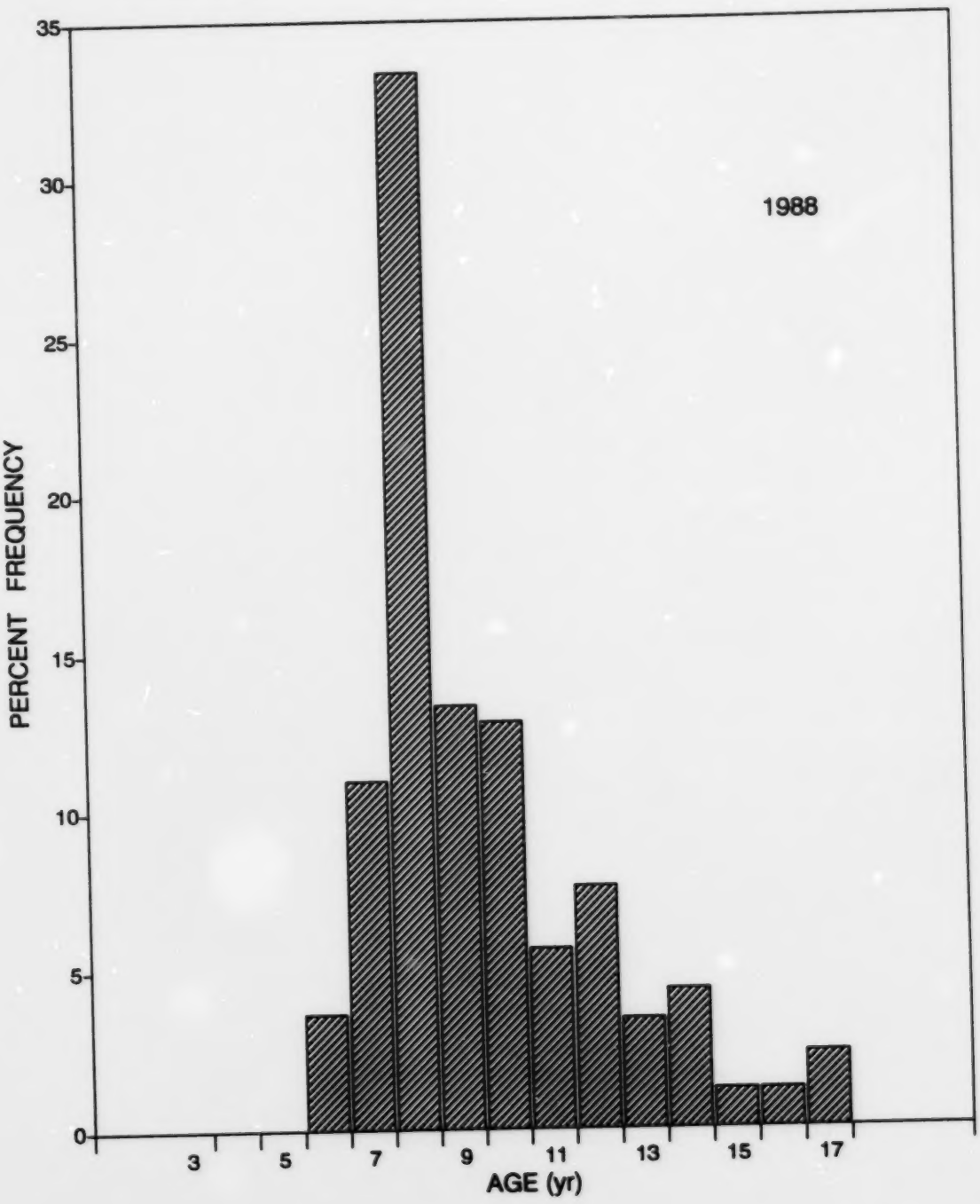


Fig. 10. Calculated age-frequency distribution of the Arctic charr run in Freshwater Creek, 1988.

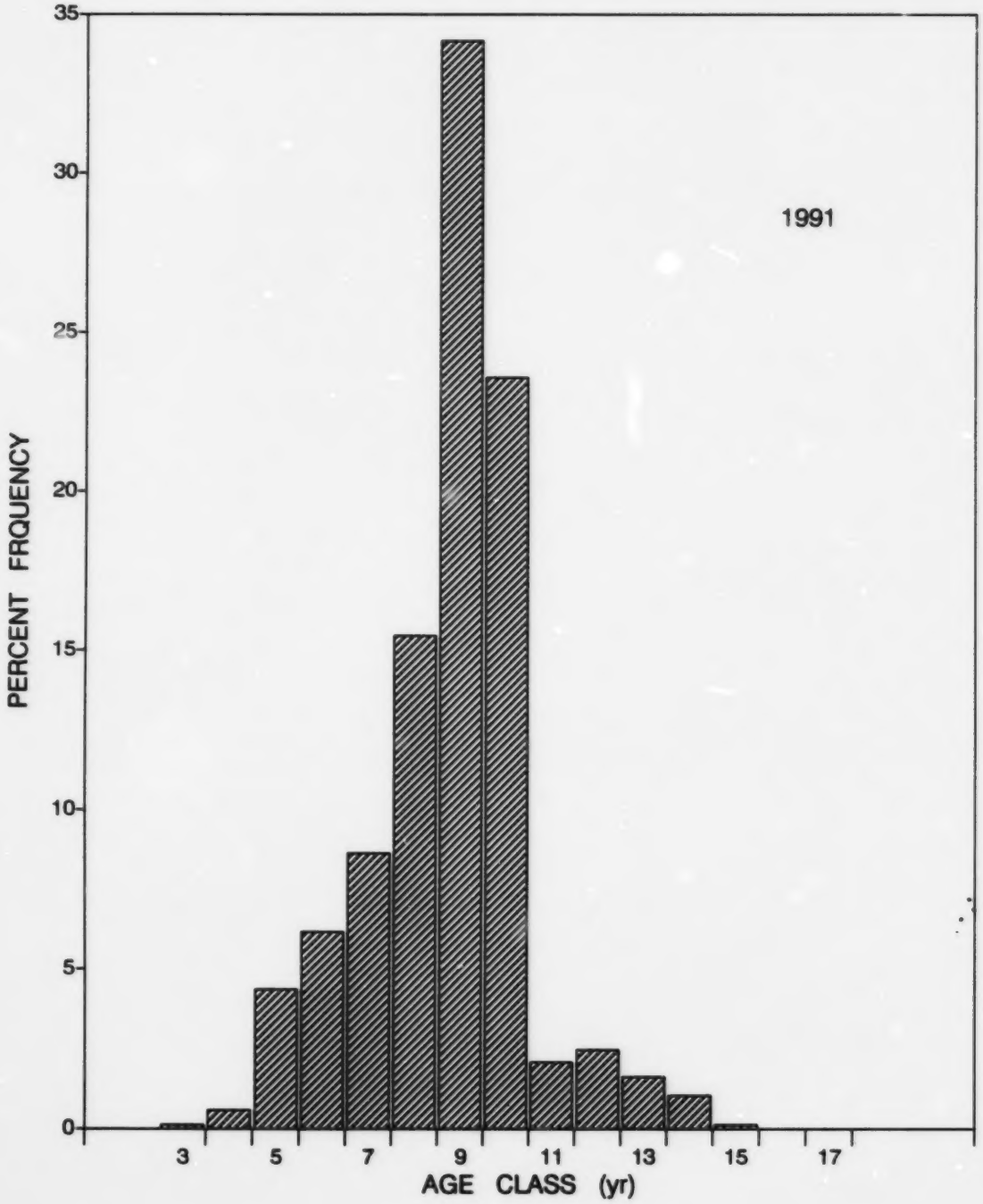


Fig. 11. Calculated age-frequency distribution of the Arctic charr run in Freshwater Creek, 1991.

Table 1. Summary of the number of Arctic charr sampled (live and tagged), the daily length-frequency distribution and the number counted per day, Freshwater Creek fish weir, 1982.

Date	Number Sampled	Sample Length-Frequency Distribution (mm)														Daily Count
		150	200	250	300	350	400	450	500	550	600	650	700	750	800	
August 20	9							2	3	3		1				9
21	40					2	5	5	9	10	6	1	2			41
22	46			1	1	6	7	8	9	10	4					48
23	102				3	18	22	19	19	11	7	2		1		102
24	125					9	11	21	36	33	14	1				282
25	98					2	1	4	22	45	20	3		1		1448
26	150					5	29	19	29	49	12	6	1			3003
27	217				1	8	39	38	52	54	20	5				1589
28	111					10	25	23	26	20	7					1911
29	187					13	44	28	36	42	17	6		1		686
30	43					6	9	6	6	13	3					249
31	55					7	6	11	9	14	6	2				60
September 1	218			1	1	18	41	29	45	54	29					251
2	66					3	13	5	18	19	7	1				76
3	65				3	4	15	14	7	15	4	1	2			76
4	65		2	3	4	10	12	5	8	12	6	2	1			66
5	37		1	1	3	5	5	2	6	8	4	1		1		37
6	21		3	4	2	1	5		2	1	3					21
7	6						5				1					6
Total	1661		6	10	18	127	294	239	342	413	170	32	6	4		9961

Table 2. Summary of the number of Arctic charr live sampled, the daily length-frequency distribution and the number counted per day, Freshwater Creek fish weir, 1988.

Date	Number Sampled	Sample Length-Frequency Distribution (mm)													Daily Count
		150	200	250	300	350	400	450	500	550	600	650	700	750	800	
August 20	65			8	6	14	14	12	5	1	3		1		1	87
21	78			6	14	22	13	14	8	1						122
22	116			4	25	26	21	28	5	4	1	1		1		218
23	161			6	28	38	34	27	18	5	3	2				317
24	150			3	20	48	33	28	9	5	3		1			941
25	150			2	22	50	36	24	7	2	5	1	1			2421
26	150			2	26	52	35	19	9	2	3	1	1			2816
27	150				27	52	26	20	9	10	3	3				1832
28	150			4	15	26	31	26	18	11	15	4				1199
29	145		1	2	21	32	29	11	14	15	18		2			2270
30	150			4	22	36	29	19	16	14	5	3	2			2519
31	150			2	19	35	40	19	14	7	8	5	1			3619
September 1	150			7	12	36	34	29	14	14	1	2	1			2441
2	150			7	13	38	27	27	19	7	8	2	1	1		4523
3	150			7	31	33	23	25	11	8	6	5	1			3717
4	150			7	23	32	18	28	19	12	6	3	2			1008
5	150			9	20	20	27	25	19	14	11	2	2		1	896
6	150		1	8	20	33	20	22	18	17	5	4	1	1		1149
7	150			23	33	21	32	18	12	4	6	1				1103
8	150		3	27	26	27	18	15	10	13	9	2				674
9	115		3	20	22	20	12	13	12	6	4	3				538
10	120		4	29	36	18	10	10	6		5	1		1		628
11	125		8	38	26	15	4	7	11	9	5	2				677
12	100		10	36	19	6	7	4	13	2	2		1			538
13	71		7	24	11	9	3	6	5	1	2	2	1			203
14	75		11	20	12	2	5	3	9	5	6	1	1			148
15	60		1	11	6	8	6	4	13	3	4	3	1			109
16	62		6	23	4	1	5	4	8	5	2	3	1			83
17	46		3	20	3	3	2	2	2	3	5	1	1	1		51
18	38	1	2	8	4	1	1	3	8	7	2		1			54
19	23		8	7	2	2	2		1		1					32
Total	3650		67	368	572	759	597	490	337	208	162	59	23	6	2	36933

Table 3. Summary of the number of Arctic charr live sampled, the daily length-frequency distribution and the number counted per day, Freshwater Creek fish weir, 1991.

Date	Number Sampled	Sample Length-Frequency Distribution (mm)														Daily Count
		200	250	300	350	400	450	500	550	600	650	700	750	800	850	
August 13	46		1			2	5	16	15	4	1		2			49
14	30					3	1	11	9	5		1				36
15	23			1		1	2	7	7	4	1					23
16	11				1	1	2	1	4	2						11
17	20				2		2	4	6	3		3				21
18	35				2	1	6	10	10	3	2		1			35
19	9		1	1		1		1	2	3						9
20	10							5	2	2		1				11
21	53				1	3	7	8	17	9	6	1		1		53
22	172			1	3	10	26	43	43	32	7	3	2		2	256
23	171			5	17	15	32	45	34	18	4		1			439
24	157		3	8	13	24	27	47	29	4	2					1369
25	160		3	19	44	26	29	28	10	1						1831
26	169		3	9	34	42	35	20	22	3	1					1923
27	145	1	2	10	38	46	22	17	7	2						1609
28	151			4	26	37	35	24	14	8	1	1	1			2934
29	128	1	4	7	25	36	27	16	9	3						7091
30	146		4	15	30	40	18	23	13	3						2360
31	136		7	24	34	21	19	13	10	2	3	3				4165
September 1	149			11	28	37	23	18	14	13	2	3				3689
2	150	2	4	19	30	33	22	13	19	7	1					3108
3	100		7	23	11	12	8	17	11	9	2					2761
4	87		20	26	13	9	3	5	3	3	3		1	1		902
5	160	1	25	54	31	15	12	5	12	1	3	1				2689
6	64	1	3	8	4	10	14	12	10	2						1072
7	116		10	19	15	18	18	21	8	6	1					311
8	157	2	34	55	33	13	9	2	7	1	1					384
9	59	1	7	14	3	7	13	13	1							208
10	58	1	10	14	14	10	3	4	1		1					147
11	53		3	3	5	8	14	12	4	3		1				63
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
Total	2925	10	151	350	457	481	434	461	353	156	42	18	8	2	2	39559

Table 4. Biological data by length interval for Arctic charr live sampled and tagged at the Freshwater Creek fish weir, 20 August to 7 September 1982.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)	ROUND WEIGHT(G) MEAN	SD	K
200	6	0	235	167	61	1.27
250	10	1	282	295	98	1.31
300	18	1	324	431	116	1.27
350	127	8	381	688	196	1.24
400	294	18	425	912	161	1.19
450	239	14	476	1269	216	1.18
500	342	21	526	1814	318	1.25
550	413	25	572	2368	391	1.27
600	170	10	621	3162	430	1.32
650	32	2	668	3889	543	1.30
700	6	0	719	4508	467	1.21
750	4	0	760	5525	419	1.26
TOTAL	1661					
MEAN			510	1794	912	1.24

Table 5. Biological data by length interval for Arctic charr live sampled at the Freshwater Creek fish weir, 20 August to 19 September 1988.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)	ROUND WEIGHT(G) MEAN	SD	K
150	1	0	199	100	-	1.27
200	68	2	237	184	41	1.38
250	374	10	277	278	71	1.29
300	568	16	326	441	97	1.27
350	756	21	375	675	104	1.27
400	597	16	424	987	146	1.29
450	492	13	473	1386	199	1.30
500	342	9	522	1866	256	1.31
550	207	6	573	2486	337	1.32
600	157	4	623	3305	336	1.37
650	57	2	669	4082	351	1.36
700	24	1	720	4944	550	1.33
750	5	0	766	6290	1220	1.39
800	2	0	817	6775	318	1.24
TOTAL	3650					
MEAN			419	1155	949	1.29

Table 6. Biological data by length interval for Arctic charr live sampled at the Freshwater Creek fish weir, 13 August to 12 September 1991.

LENGTH INTERVAL (MM)	NO.	PERCENT	MEAN FORK LENGTH(MM)	ROUND WEIGHT(G) MEAN	ROUND WEIGHT(G) SD	K
200	4	0	238	213	25	1.57
250	42	2	288	279	65	1.16
300	224	8	327	402	70	1.15
350	434	16	376	617	112	1.16
400	480	18	424	894	183	1.17
450	434	16	472	1213	196	1.15
500	461	17	525	1637	274	1.13
550	353	13	572	2174	311	1.16
600	154	6	620	2794	315	1.17
650	42	2	667	3471	491	1.17
700	18	1	722	4497	560	1.19
750	8	0	774	5563	441	1.20
800	2	0	804	5788	371	1.12
850	2	0	863	7413	230	1.16
TOTAL	2658					
MEAN			469	1345	858	1.16

Table 7. Biological data by age-group of the sacrificed sample of Arctic charr stratified by length, Freshwater Creek fish weir, 20 August to 7 September 1982.

AGE (YR)	MALES N	MALES LENGTH(MM) MEAN	MALES LENGTH(MM) SD	MALES WEIGHT(G) MEAN	MALES WEIGHT(G) SD	MALES K	MALES % MAT	FEMALES N	FEMALES LENGTH(MM) MEAN	FEMALES LENGTH(MM) SD	FEMALES WEIGHT(G) MEAN	FEMALES WEIGHT(G) SD	FEMALES K	FEMALES % MAT	COMBINED N	COMBINED LENGTH(MM) MEAN	COMBINED LENGTH(MM) SD	COMBINED WEIGHT(G) MEAN	COMBINED WEIGHT(G) SD	COMBINED K	COMBINED % MAT
6	2	302	21	275	106	0.98	0	1	304	-	300	-	1.07	0	8	278	28	225	80	1.01	0
7	1	319	-	300	-	0.92	0	2	310	7	285	21	0.96	0	4	305	17	268	47	0.94	0
8	12	404	54	729	347	1.04	0	13	378	50	571	249	1.02	0	25	391	53	650	306	1.03	0
9	4	411	80	725	352	0.97	0	3	449	23	950	87	1.05	0	7	427	62	821	281	1.00	0
10	4	520	63	1498	460	1.05	25	3	507	53	1400	458	1.05	0	7	514	54	1456	423	1.05	14
11	8	549	72	1863	829	1.06	13	7	523	49	1607	453	1.09	0	15	537	62	1743	670	1.07	7
12	8	585	65	2375	1068	1.12	25	10	543	85	1850	992	1.05	20	18	562	78	2083	1031	1.08	22
13	10	610	93	2776	1314	1.13	40	2	526	50	1500	424	1.02	0	12	596	91	2563	1295	1.11	33
14	2	667	10	3575	318	1.20	100	1	608	-	2200	-	0.98	100	3	647	35	3117	825	1.13	100
15	2	712	13	4200	990	1.16	100	-	-	-	-	-	-	-	2	712	13	4200	990	1.16	100
18	-	-	-	-	-	-	-	1	668	-	4000	-	1.34	100	1	668	-	4000	-	1.34	100
TOTAL	53							43							102						
MEAN		517	123	1806	1297	1.07			468	104	1279	898	1.05			482	126	1491	1174	1.06	
MEAN AGE	10.6							10.1							10.2						

Table 8. Biological data by length interval of the sacrificed sample of Arctic charr stratified by length, Freshwater Creek fish weir, 20 August to 7 September 1982.

LENGTH INTERVAL (MM)	MALES N	MALES LENGTH(MM) MEAN	MALES WEIGHT(G) MEAN	MALES WEIGHT(G) SD	MALES K	MALES % MAT	FEMALES N	FEMALES LENGTH(MM) MEAN	FEMALES WEIGHT(G) MEAN	FEMALES WEIGHT(G) SD	FEMALES K	FEMALES % MAT	COMBINED N	COMBINED LENGTH(MM) MEAN	COMBINED WEIGHT(G) MEAN	COMBINED WEIGHT(G) SD	COMBINED K	COMBINED % MAT
200	-	-	-	-	-	-	-	-	-	-	-	-	2	241	125	35	0.89	0
250	2	291	225	35	0.91	0	-	-	-	-	-	-	7	278	214	38	0.99	0
300	3	323	367	76	1.08	0	8	322	340	71	1.01	0	12	323	348	67	1.02	0
350	7	375	521	70	0.98	0	3	372	533	104	1.03	0	10	374	525	75	1.00	0
400	7	437	836	90	1.00	0	9	422	794	62	1.04	0	16	429	813	77	1.02	0
450	6	472	1090	99	1.03	17	8	476	1063	103	0.98	0	14	474	1074	98	1.01	7
500	6	516	1443	116	1.05	0	5	529	1630	157	1.10	20	11	522	1528	161	1.07	9
550	6	571	1950	237	1.04	17	8	565	2019	231	1.11	0	14	568	1989	227	1.08	7
600	10	618	2705	293	1.15	20	2	609	2475	389	1.10	50	12	616	2667	303	1.14	25
650	4	680	4000	528	1.27	100	1	668	4000	-	1.34	100	5	677	4000	457	1.28	100
700	5	715	4160	691	1.13	100	1	709	3850	-	1.08	100	6	714	4108	631	1.12	100
TOTAL	56						45						109					
MEAN		519	1818	1296	1.07			468	1279	884	1.05			480	1479	1173	1.06	

Table 9. Biological data by age-group for Arctic charr dead sampled at the Freshwater Creek fish weir, 20 August to 19 September 1988.

AGE (YR)	MALES							FEMALES							COMBINED						
	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	SD	WEIGHT(G) MEAN	SD	K	% MAT
5	1	270	-	269	-	1.37	0	1	256	-	209	-	1.25	0	2	263	10	239	42	1.31	0
6	6	282	39	269	122	1.15	0	2	237	4	144	6	1.09	0	8	270	39	238	118	1.14	0
7	6	345	58	534	351	1.19	17	11	295	27	295	105	1.11	0	18	310	45	373	238	1.15	6
8	20	356	43	553	228	1.16	5	13	385	33	696	191	1.18	0	33	367	42	610	223	1.17	3
9	4	476	57	1383	528	1.22	75	10	405	51	888	368	1.26	50	14	426	60	1029	460	1.25	57
10	5	449	43	1203	368	1.28	40	8	443	37	1135	336	1.28	88	13	445	38	1161	335	1.28	69
11	2	480	5	1299	172	1.18	100	4	474	52	1198	402	1.09	100	6	476	40	1232	325	1.12	100
12	5	482	53	1474	545	1.26	60	2	536	107	2229	1324	1.36	100	7	497	67	1690	791	1.29	71
13	1	494	-	1452	-	1.20	100	2	591	48	2658	255	1.30	100	3	559	66	2256	719	1.27	100
14	1	782	-	5547	-	1.16	100	3	573	57	2514	717	1.32	100	4	625	115	3273	1626	1.28	100
15	1	569	-	2600	-	1.41	100	-	-	-	-	-	-	-	1	569	-	2600	-	1.41	100
16	-	-	-	-	-	-	-	1	594	-	2863	-	1.37	100	1	594	-	2863	-	1.37	100
17	-	-	-	-	-	-	-	2	573	13	2542	195	1.35	100	2	573	13	2542	195	1.35	100
TOTAL	52							59							112						
MEAN		394	100	909	868	1.20			410	102	1031	817	1.21			401	101	967	838	1.21	
MEAN AGE		8.7							9.4							9.1					

Table 10. Biological data by length interval for Arctic charr dead sampled at the Freshwater Creek fish weir 20 August to 19 September 1988.

LENGTH INTERVAL (MM)	MALES						FEMALES						COMBINED					
	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT	N	LENGTH(MM) MEAN	WEIGHT(G) MEAN	SD	K	% MAT
200	-	-	-	-	-	-	3	239	144	5	1.06	0	3	239	144	5	1.06	0
250	9	273	248	49	1.20	0	6	272	212	25	1.06	0	16	273	235	43	1.15	0
300	12	329	402	72	1.11	0	9	318	380	69	1.17	0	21	325	393	70	1.14	0
350	10	372	609	102	1.17	0	11	374	606	61	1.16	18	21	373	607	81	1.16	10
400	6	422	910	152	1.20	33	14	421	937	148	1.25	43	20	422	929	146	1.23	40
450	11	475	1357	138	1.27	73	8	469	1332	132	1.29	100	19	472	1347	132	1.28	84
500	3	535	2012	22	1.32	100	4	526	1823	348	1.25	100	7	530	1904	266	1.28	100
550	1	569	2600	-	1.41	100	4	574	2606	207	1.37	100	5	573	2605	179	1.38	100
600	-	-	-	-	-	-	3	625	3113	253	1.28	100	3	625	3113	253	1.28	100
750	1	782	5547	-	1.16	100	-	-	-	-	-	-	1	782	5547	-	1.16	100
TOTAL	53						62						116					
MEAN		393	900	862	1.20			407	1010	805	1.21			400	954	829	1.21	

Table 11. Biological data by age-group of the sacrificed sample of Arctic charr stratified by length, Freshwater Creek fish weir, 13 August to 12 September 1991.

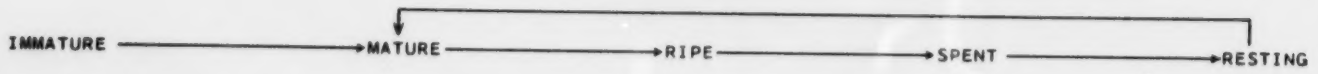
AGE	MALES							FEMALES							COMBINED						
	LENGTH(MM)			WEIGHT(G)			%	LENGTH(MM)			WEIGHT(G)			%	LENGTH(MM)			WEIGHT(G)			%
(YR)	N	MEAN	SD	MEAN	SD	K	MAT	N	MEAN	SD	MEAN	SD	K	MAT	N	MEAN	SD	MEAN	SD	K	MAT
3	2	244	5	137	17	0.95	0	-	-	-	-	-	-	-	2	244	5	137	17	0.95	0
4	2	207	7	97	6	1.09	0	4	260	25	175	38	0.99	0	6	242	34	149	50	1.02	0
5	9	260	19	185	36	1.04	0	9	273	21	223	51	1.08	0	18	267	21	204	47	1.06	0
6	4	272	42	229	111	1.07	0	12	312	26	312	75	1.02	0	16	302	34	291	90	1.03	0
7	5	354	44	469	221	1.01	0	5	342	64	455	315	1.02	0	11	346	50	450	247	1.01	0
8	8	393	40	642	248	1.02	0	10	413	49	726	268	0.99	20	19	403	44	676	255	0.99	11
9	11	460	80	1060	663	0.99	0	12	440	70	985	473	1.08	17	26	450	69	1015	529	1.03	19
10	11	576	55	2300	557	1.19	0	11	530	38	1636	427	1.09	64	22	553	52	1968	592	1.14	32
11	1	705	-	4500	-	1.28	0	-	-	-	-	-	-	-	5	649	102	3516	1337	1.21	80
12	5	719	43	4728	928	1.26	20	3	603	155	2621	1623	1.05	33	10	666	98	3794	1446	1.20	40
13	2	591	129	2637	1517	1.21	0	1	706	-	3800	-	1.08	100	3	629	113	3025	1266	1.17	33
14	2	731	98	4176	1310	1.06	50	1	594	-	2290	-	1.09	100	3	685	105	3547	1429	1.07	67
15	1	733	-	4772	-	1.21	100	-	-	-	-	-	-	-	1	733	-	4772	-	1.21	100
TOTAL	63							68							142						
MEAN		449	169	1492	1578	1.08			401	120	879	843	1.05			433	148	1246	1326	1.07	
MEAN AGE		8.4							7.8							8.2					

Table 12. Biological data by length interval of the sacrificed sample of Arctic charr stratified by length, Freshwater Creek fish weir, 13 August to 12 September 1991.

LENGTH INTERVAL	MALES						FEMALES						COMBINED					
	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%	LENGTH(MM)		WEIGHT(G)			%
(MM)	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT	N	MEAN	MEAN	SD	K	MAT
200	7	230	126	23	1.03	0	2	241	145	3	1.04	0	9	233	131	22	1.03	0
250	10	265	196	42	1.05	0	13	270	207	40	1.05	0	24	268	200	41	1.04	0
300	4	322	345	67	1.02	0	19	325	351	50	1.02	0	24	324	349	50	1.02	0
350	8	376	501	96	0.93	0	2	390	621	30	1.05	0	11	379	517	98	0.94	0
400	8	420	845	268	1.12	0	14	428	798	173	1.01	21	22	425	815	207	1.05	14
450	3	463	982	28	0.99	0	9	477	1213	133	1.11	67	12	474	1155	155	1.08	50
500	4	525	1612	174	1.12	0	6	522	1420	182	1.00	67	10	523	1497	196	1.05	40
550	7	570	2090	349	1.12	0	7	572	2056	273	1.10	71	14	571	2073	302	1.11	36
600	5	626	2809	200	1.15	0	5	616	2799	416	1.19	60	10	621	2804	308	1.17	30
650	4	674	3627	397	1.19	25	5	669	3643	405	1.22	80	9	671	3636	376	1.20	56
700	4	728	4928	361	1.28	25	4	715	3674	459	1.01	75	8	722	4301	772	1.14	50
750	1	771	5650	-	1.23	0	-	-	-	-	-	-	1	771	5650	-	1.23	0
800	1	800	5102	-	1.00	100	-	-	-	-	-	-	1	800	5102	-	1.00	100
TOTAL	66						86						155					
MEAN		450	1485	1552	1.08			438	1195	1124	1.06			441	1301	1325	1.06	

Appendix 1. A description of the relative stages of maturity used for northern fishes.

MATURITY FLOW CHART



FISH MATURITY CODE

Maturity Stage	Female		Male	
Immature (virgin)	1	-Ovaries granular in texture -hard and triangular in shape -up to full length of body cavity -membrane firm -eggs distinguishable	6	-Testes long and granular -tubular and scalloped shape -up to full body length -putty like firmness
Mature	2	-Current year spawner -ovary fills body cavity -eggs near full size but not loose -not expelled by pressure	7	-Current year spawner -testes large and lobate -white to purplish color -centers may be fluid -milt not expelled by pressure
Ripe	3	-Ovaries greatly extended & fill body cavity -eggs full size and transparent -eggs expelled by slight pressure	8	-Testes full size -white and lobate -milt expelled by slight pressure
Spent	4	-Spawning complete -ovaries ruptured and flaccid -seed eggs visible -some retained eggs in body cavity	9	-Spawning complete -testes flaccid with some milt -blood vessels obvious -testes violet-pink in color
Resting	5	-Ovary 40-50% of body cavity -membrane thin, loose, & semi-transparent -healed from spawning -seed eggs apparent with few atretic eggs -some eggs may be retained in body cavity	10	-Testes tubular, less lobate -healed from spawning -no fluid in center -usually full length -mottled and purplish in color
Unknown (virgin)	0	-cannot be sexed -gonads long or short & thin -transparent or translucent		
Unknown (non-virgin)	11	-resting fish -has spawned but gonads regenerated -sexing not possible		